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08/988,686

12/11/1997

ANTHONY J. KONECNI

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EXAMINER

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**MAILED**  
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**GROUP 2800**

**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Paper No. 02062006

Application Number: 08/988,686  
Filing Date: December 11, 1997  
Appellants: KONECNI ET AL.

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Jay M. Cantor  
For Appellant

Supplemental  
**EXAMINER'S ANSWER**

Pursuant to the Remand under 37 CFR 1.193(b)(1) by the Board of Patent Appeals and Interferences on September 27, 2005, a supplemental Examiner's Answer is set forth below:

This application was remanded in order for the Examiner to file a Supplemental Examiner's Answer wherein the full English translation is relied upon.

**(1) Real Party in Interest**

A statement identifying by name the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows:

**WITHDRAWN REJECTIONS**

The following grounds of rejection are not presented for review on appeal because they have been withdrawn by the examiner. The rejection of claims 21-32 under 35 U.S.C. 112, second paragraph, has been withdrawn.

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

6,008,139	Pan et al.	12/1999
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JP 4-171744	Masanori	06/1992
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Takeyasu et al., "Characterization of Direct-Contact Via Plug Formed by Using Selective Aluminum Chemical Vapor Deposition", Japn. J. Appl. Phys., Vol. 33 (1994), pp. 424-428.

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

Claims 21-26, 29, and 30 rejected under 35 U.S.C. 103(a) as being unpatentable over Masanori, JP 4-171744, in view of Takeyama et al., the article entitled "Characterization of Direct-Contact Via Plug Formed by Using Selective Aluminum Chemical Vapor Deposition".

Masanori discloses a method of fabricating an electronic device comprising the steps of forming a first electrically conductive structure comprising aluminum 3; forming an insulating layer 4 extending above the first electrically conductive structure, the insulating layer having an opening with sidewalls and a bottom exposing a portion of the first electrically conductive structure, as shown in Figure 1 and disclosed in the third paragraph on page 4 of the English-language translation (under the section entitled "Application example"); providing a gas comprising argon and hydrogen incorporated within a plasma into the opening to remove a denatured layer formed on the first electrically conductive structure (disclosed in the fourth paragraph on page 4 of the translation); then depositing a conductive material comprising aluminum 5 into the opening by sputtering (disclosed in the fifth paragraph on page 4 of the translation and in the second paragraph on page 3 of the translation).

Masanori does not disclose that the conductive material deposited into the contact opening is deposited by Chemical Vapor Deposition (CVD). However, Takeyasu et al. disclose a method of forming multi-layered interconnections having both the upper and lower conductive layers comprising aluminum wherein an aluminum plug

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is formed in the contact hole by selective CVD after a cleaning step is performed, see the abstract and Figure 1(b). The method of Takeyasu et al. is low cost and yields a high performance interconnection with low via resistance, therefore, it would have been obvious to one skilled in the art that the aluminum/aluminum direct contact via structure of Takeyasu et al. could have been substituted for the upper aluminum layer of Masanori. The via structure of Takeyasu et al. also ensures complete filling of the via.

Masanori et al. disclose that other rare gases can be used in place of argon (note the last sentence on page 4 of the translation). Therefore, it would have been obvious to one skilled in the art to use helium in the known method of Masanori et al.

The plasma power of about 150 watts to about 450 watts is a processing parameter which would have been obvious to optimize. The power at which a plasma is generated from is a well known processing variable and the discovery of the optimum or workable plasma power range involves only routine skill in the art and is ascertainable by routine experimentation. Furthermore, the specification contains no disclosure of either the critical nature of the claimed plasma power or any unexpected results arising therefrom. In any case, it would have been an obvious matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose the particular claimed range of powers because Appellant has not disclosed that these plasma powers are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using other powers. Indeed, it has been held that optimization of range limitations are prima facie obvious absent a

disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical.

Claims 27, 28, 31, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masanori, JP 4-171744, in view of Takeyama et al., the article entitled "Characterization of Direct-Contact Via Plug Formed by Using Selective Aluminum Chemical Vapor Deposition", as applied to claim 21 above, and further in view of Pan et al., U.S. Patent 6,008,139.

Masanori et al. and Takeyasu et al. are applied as above. Masanori et al. fail to disclose that the plasma has a bias power up to about 300 watts.

Pan et al. teach that a bias power of from about 20 to about 1000 watts is applied to a plasma used to etch material in order to provide a more anisotropic and directional etch perpendicular to the surface of the substrate (column 6, lines 16-30). It would have been obvious to one of ordinary skill in the art at the time the invention was made to apply a bias to the plasma of Masanori et al., since, as taught by Pan et al., a biased etching plasma will provide a more anisotropic and directional etch perpendicular to the surface of the substrate thereby increasing the effectiveness at which the plasma gas is delivered to the surface of the conductive material at the bottom of the contact hole in the known method of Masanori et al. Furthermore, it would have been an obvious matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose the particular bias power recited in claims 27 and 28 because Appellant has not disclosed that this bias power is for a particular unobvious purpose, produces an unexpected result, or is

otherwise critical, and it appears prima facie that the process would possess utility using another bias power. Indeed, it has been held that optimization of range limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical.

#### **(10) Response to Argument**

As correctly pointed out by Appellant, the principal inventive feature set forth in the claims on appeal relates to the step of removing residue from an exposed portion of a conductive layer through an opening in an insulating layer by providing a halogen-free gas comprised of hydrogen incorporated within a plasma into the opening in the insulating layer and onto the exposed portion and at least partially remove the residual material. This is the exact problem that is addressed by Masanori, note the sections of the translation entitled "Prior Art" (on page 2 of the translation) and "Problem to be solved by the invention" (on page 3 of the translation). Appellant has incorrectly argued, however, that the Masanori patent applied in the rejection of the appealed claims uses a halogen-based chemistry to remove this residual material. Masanori refers to the residual material on the aluminum wiring layer as a denatured or degenerated layer, indicated by reference numeral 6 in Figure 2. Masanori uses a plasma consisting of argon and hydrogen to clean the surface of the aluminum wiring exposed through a contact hole and remove this denatured layer. The plasma is clearly halogen-free, see the sections of the English language translation entitled "Means to solve the problem", "Function", and "Application example". The plasma of Masanori clearly consists of argon and hydrogen (H<sub>2</sub>), although it is disclosed that other rare gases can be used in



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the plasma instead of argon. It is further disclosed that the hydrogen in the plasma combines with fluorine and oxygen in the denatured layer to form water ( $H_2O$ ) and hydrofluoric acid (HF). The end-products of the chemical reaction which results in the cleaning of the exposed portion of the aluminum layer by etching with the argon-hydrogen plasma are water and hydrofluoric acid, however, no gases containing a halogen are used in the plasma. Hence, it is the end-products of the chemical reaction which are halogen-containing and not the plasma itself. The claims, as presently drafted, do not preclude the removed residual material from being halogen-containing. Masanori clearly teaches a non-halogen chemistry for removing a denatured layer formed on the surface of an aluminum wiring.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.



Respectfully submitted,

M. Wilczewski